SSVEO IFA List

Date: 02/27/2003

STS - 39, OV - 103, Discovery (12)

Time: 04:17:PM

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-39-V-01	EPD&C, ECLSS
EECOM-01	**GMT:** Prelaunch		**SPR** 39RF01	**UA**	**Manager:**
			IPR	**PR** OEL-3-13-0085	
					Engineer:

Title: FES Feedline "A" System Heater #2 Failure. (ORB)

Summary: DISCUSSION: Before launch, the flash evaporator system (FES) feedline "A" heater string #2 temperature was below Launch Commit Criteria (LCC) acceptable limits. Heater string #1 was reselected and used during the mission.

Postflight troubleshooting confirmed a failed Load Control Assembly (LCA) #2 hybrid driver output. Further troubleshooting revealed several locations in the FES heater circuit where the wire was damaged or shorted. Troubleshooting of the FES wiring thermal switches and heater elements has not revealed any other off nominal components. CONCLUSION: The failure of the FES feedline "A" string #2 heater was caused by damaged wiring in the heater circuit. The shorting of this wiring to the structure caused the LCA #2 hybrid driver to fail. CORRECTIVE_ACTION: The failed LCA #2 has been replaced with an available spare. The FES heater circuit wires were replaced from the avionics bay 5 interface to the splice at the FES heater. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:16	Problem	**FIAR**	**IFA** STS-39-V-02	APU
MMACS-02	**GMT:** 118:11:50		**SPR** 39RF02	**UA**	**Manager:**
			IPR	**PR** APU-3-13-0284	
					Engineer:

Title: APU 2 Fuel Pump/GGVM Cooling System "A" Valve Did Not Operate. (ORB)

Summary: DISCUSSION: Following post-ascent auxiliary power unit (APU) shutdown, no cooling was noted on the APU 2 fuel pump/gas generator valve module (FP/GGVM) with cooling system A selected. Data indicate that the water pulse valve (LV25) failed to operate when activated, apparently failing closed. The B system was later activated and normal cooling occurred. Nominal cooling was achieved using the B system for the remainder of the flight.

Prior testing of the FP/GGVM cooling water valves has shown that they are susceptible to nickel hydroxide contamination which affects the valve bellows and renders the valve inoperative. Because of this contamination problem, a 9-month life limit was placed on the FP/GGVM cooling water valves. Although this limit was sufficient for the original STS-39 launch date, a launch delay (including rollback) caused by ET door hinge cracks resulted in an exception (EV2123R1) being written prior to flight which extended the life limit of the Orbiter's eight FP/GGVM cooling valves by 45 days. These particular valves had exceeded their life limit by 32 days at the time of launch. CONCLUSION: APU 2 FP/GGVM cooling system A pulse valve (LV25) failed to operate when activated after ascent. The most probable cause for this valve to fail closed is nickel hydroxide corrosion of the bellows. The 9-month life limit was exceeded by 32 days on the day of launch. CORRECTIVE_ACTION: All eight of the Orbiter's FP/GGVM cooling water valves were removed and replaced. The suspect APU 2 system "A" valve was sent to Rockwell/Downey for failure analysis. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:03:40	Problem	**FIAR**	**IFA** STS-39-V-03	OMS/RCS
PROP-02	**GMT:** 118:15:14		**SPR** 39RF03	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: F5R Fuel Injector Temp Low. (ORB)

Summary: DISCUSSION: Reaction control subsystem (RCS) vernier thruster F5R fuel injector temperature sensor (V42T1532C) was biased low during the STS-39 mission. During prelaunch, the fuel injector temperature was 5 ?F greater than the oxidizer which is a nominal condition. However, after ascent, the fuel injector temperature shifted to about 10 ?F lower than the oxidizer injector temperature, and throughout the flight as injector temperatures increased, the difference between the injector temperatures increased. The difference ranged from approximately 10 ?F at 140 ?F to 50 ?F at 250 ?F. During postlanding operations at KSC, the fuel and oxidizer injector temperatures were both indicating 78 ?F. This isolated the bias to the sensor and not elsewhere in the processing of the signal from the sensor. A valve leak was also eliminated as a possible cause of the bias.

The vernier thruster injector temperature sensors are press fit into a drilled hole. Early in the program, the sensors had a tendency to loosen and this resulted in a poor thermal contact. As was seen during STS-3, -4, and -6, the poor contact resulted in a temperature bias that increased with increasing temperature. This problem was fixed by a 1983 design change that utilized thermal grease in the sensor hole to ensure adequate thermal contact. However, the STS-39 vernier F5R was manufactured before the thermal grease addition was implemented. CONCLUSION: The temperature bias was most likely caused by poor sensor contact. With normal vernier thruster usage on orbit, the injector temperature is not likely to reach its fail-leak limit of 130?F. This is not considered to be a significant problem and it is recommended to fly-as-is. The thruster should be repaired the next time the forward module is removed. CORRECTIVE_ACTION: Add thermal grease to the vernier thruster F5R injector temperature sensors (fuel and oxidizer) the next time forward module FRC3 is removed. EFFECTS_ON_SUBSEQUENT_MISSIONS: It is possible that sensor contact could worsen and, when combined with limited vernier thruster firings, could result in the fuel injector temperature dropping below the 130 ?F fail-leak limit. If this were to occur, and a leak was not suspected, a general purpose computer memory write (GMEM could be implemented to lower the fuel leak detection limit to 90 ?F. Since the oxidizer temperature measurement is located adjacent to the fuel measurement, it is redundant to the fuel measurement and will detect both oxidizer and fuel leaks.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR** BFCE-029-F035	**IFA** STS-39-V-04	DPS
DPS-02	**GMT:** Prelaunch		**SPR** 39RF04	**UA**	**Manager:**
			IPR	**PR** DIG-3-13-0236	
					Engineer:

Title: Uncommanded Operations-2 Recorder Function. (ORB)

Summary: DISCUSSION: The Operations (OPS)-2 recorder (ser. no. 1018) experienced an uncommanded reconfiguration before launch and was found to be recording just after the backup flight system (BFS) operational sequence (OPS) 1 transition and in general purpose computer (GPC) 5. The recorder was commanded to stop and responded nominally to the command; track 7 was determined to be 19 percent full. No Launch Commit Criteria (LCC) violation occurred; a decision was made to use a normal recorder configuration for flight, and the recorder performed nominally during ascent. A second occurrence was noted at 125:14:21:18 G.m.t. in the primary avionics software system (PASS) and GPC 4. The recorder changed speed, stopped, restarted, jumped tracks and changed to serial operational mode.

An investigation into all possible causes that could be identified for the recorder anomalies has isolated the most probable cause to be the payload forward (PF) 2 multiplexer-demultiplexer (MDM) input/output module (IOM) 10, discrete output low (DOL) card, channel 1. Laboratory testing of the suspect hardware is in progress at the vendor to confirm that certain hybrid components have failed. The failure could not be recreated on this card. Component part level testing will be performed. A summary and status of the investigation of the anomaly follows. A data review showed two commands were needed for the prelaunch anomaly to occur: one to start and one to go from track 1 to track 7. Two periods of recorder motion occurred: the first was from 118:10:32:31 to 118:10:32:35 G.m.t., and the second was from 118:10:32:36 to 118:10:35:55 G.m.t. The track position was initiated approximately 3 seconds prior to the first motion. The anomaly occurred within 2 seconds of the OPS transition as was indicated by the loss of the BFS downlist during the transition. A review of KSC MDM built in test equipment (BITE) test 4 (BT4) data and command retrievals from T-45 minutes to BT4 confirmed that the recorder was selected to track 1 prior to the anomaly. Twenty-seven seconds before the anomaly occurred, the recorder was in standby on track 1. A review of the communications security (COMSEC) authentication bits, the network signal processor (NSP) validation bits, and the mission operations computer (MOC) command history confirmed that no radio frequency (RF) commands had been transmitted from the Mission Control Center (MCC) or received by the Orbiter. A review of the KSC MDM PF1 and PF2 launch data bus activity from BT4 up until the time of the anomaly showed no commands were issued that could have caused the anomaly. It was verified that no stored program commands (SPC's) existed in the BFS. The telemetry data showed no SPC's in BFS, and the BFS was re-IPL'ed (initial program load) after the previous launch attempt. The BFS IPL for flight occurred at 115:15:40 G.m.t (4/25/91), and the BFS was left active in standby from IPL until moded to run for flight at 118:10:32:18 G.m.t. (4/28/91). KSC analysis of the GPC memory dump shows no SPC's were in the buffer during the post IPL BFS memory dump. Engineering analysis confirmed that the cyclic input/output (I/O) buffers for the payload MDM's had all zero contents for the OPS-2 recorder card and channel. Telemetry data were reviewed to verify that the BFS terminated all I/O functions during the OPS transition, therefore no mechanisms for PF1 or PF2 I/O were available during this timeframe with BFS in run, and thus eliminating the possibility of an unknown problem in the BFS flight software. Raw telemetry data from the incident were used to reconstruct a timeline that related the OPS-2 recorder changes to the BFS transition and showed that the OPS-2 recorder went into the record mode at least 1.8 seconds prior to the BFS telemetry going static (the only sign in the telemetry that the BFS is in OPS 101 transition). An engineering evaluation of the data for the time delay following the OPS 101 PRO (proceed) entry from the keyboard until the downlink stopped showed that for a worst case scenario, the OPS-2 recorder went into the record mode at least 0.6 second prior to the start of the BFS transition. Software Production Facility (SPF) test data showed that neither the BFS going to run (approximately 9 seconds before the recorder motion) nor the BFS transition (at least 0.6 second after the recorder motion) caused the anomaly; the telemetry signature could not be reproduced. No anomalies related to the OPS recorder were reported for the BFS during STS-37 prelaunch which was the first flight with the new OI8F computer software, or during the STS-39 Terminal Countdown Demonstration Test (TCDT). The GPC hardware and software were eliminated as a failure source when the second failure occurred involving GPC 4 and PASS software. The possibility of payload bus noise being misinterpreted as a valid command (primary or secondary ports) was eliminated as a cause because no indications of errors existed on the data bus from either PASS or BFS operations and extensive use of the payload buses was made without any errors. No recorded failures or unexplained anomalies (UA's) occurred during this flow for any of the associated hardware except for one UA for GPC 5 (UA3-12-0078) that was resolved as most probably resulting from an operator error. The GPC 5 IPL talkback (TB) did not indicate IPL when the IPL pushbutton (PB) was pressed. It flashed to IPL, then to barber pole (BP) for about 20 seconds after PB was pressed. The most probable cause of this unexplained condition was misinterpretation of TB by the technician. The GPC performed nominally and no indications of hardware problems existed. The source of the problem has been isolated to the recorder or payload MDM/MDM interface. A review of the failure history of OPS recorder ser. no. 1018 did not show any similar or related failures or UA's. This recorder has been installed in OV-103 since STS-33 (11/89). The JSC Flight Data Systems Division Flight Tape Recorder Laboratory performed a manual simulation of both occurrences of the anomaly MDM commands to the OPS recorder utilizing a Manual Bench Test Fixture (MBTE) for control, the Engineering Test Model 2 Shuttle Tape Recorder and data retrieved in the Mission Evaluation Room (MER). The results of the manual commanding of the recorder and resetting of the primary command fields with the MBTE "thumb wheel" switches yielded recorder status responses that very closely fit the actual flight data. The approximate time sequence could be generated by manipulating the tape laboratory MBTE primary command switches and the various thumb wheel switches on the MBTE. The sequence and time response can be duplicated in the laboratory using the Shuttle Tape Recorder Auto Test Station. The conclusion was that the tape recorder could not go into the observed mode of operation without receiving specific bit patterns from the MDM. These commands could not have resulted from spikes or transient interference because the recorder requires that a signal of approximately 5 volts to be present for 280 to 300 milliseconds. The problem is probably not in the recorder, which remains installed on OV-103. No MDM problems were observed in the data, however the payload MDM ser. no. 76 had a previous occurrence of IOM 10 failing with output bits set to uncommanded values. In 1985, KSC reported anomalous tape recorder operations on this card where multiple independent bits were set to uncommanded values (CAR AD0096 dated 7/18/85). IOM 10 bits, 0,1,2, were set to 1,0,1 when they should have been 0,1,0; also, bits 6,7 were 0,0 when they should have been 0,1. KSC later reported bits 0,1,2,11 "could not be set high" during troubleshooting. The unit was sent to the vendor (Honeywell) for failure analysis. The vendor was able to confirm the KSC report on bits 0,1,2,11 by reproducing the multiple non-contiguous DOL's at the factory in 1985 and concluded that the control hybrid which controls all DOL's on IOM 10 was the most probable cause. The control hybrid interfaces the MDM sequence control unit (SCU) to the actual driver hybrids that interface to the recorder. The suspect control hybrid card in IOM 10 was replaced and the MDM successfully passed retest. That unit was returned to the field in February 1986, installed on OV-103 in July 1989, and has flown three times. The suspect hybrid component passed all part-level electrical tests and was returned to (and is still in) bonded stores (Program Policy is not to perform destructive failure analysis unless a trend has been indicated). The diagnosis for the original IOM 10 failure was that the complementary metal oxide semiconductor (CMOS) chip technology utilized has a history of highly intermittent non-isolatable "soft" failures due to potassium contamination of the silicon in the logic chips. This contamination "migrates" within a single chip, drifting towards a junction, and when concentrations attain high enough levels, the switching characteristics of the junction are changed and a failure occurs. (Localized heating of hybrid during removal and replacement could conceivably temporarily purge ionic contamination from an affected junction.) Another similar failure was documented in 1982 by a Sperry Systems Engineering Memo. In this failure report, the suspect bus hybrid driver failed in such a way as to cause command changes without the card actually being commanded; i.e., the hybrid "opens up" to receive commands directed to other IOM's, and that means it will set random bits on all 3 channels on the card. Recorder operation is the only item on channel 1 on IOM 10 of payload MDM PF2. Before the prelaunch anomaly, the recorder reset indicated "high" which shows that the last action was erase. After the anomaly, the reset indicated "low" showing that the recorder had received a command. For the recorder to receive track change and record commands, three bit changes (independent soft failures) were required on the MDM interface; 2 track select bits (14 and 15) to change from track 1 to track 7 (bits 13 through 16 changed from 1,0,0,0 to 1,1,1,0) and one mode bit (bit 1, record serial A (RCDA) command) had to go to 1 with an adjacent bit remaining at 0. The first indication of the second OPS-2 recorder anomaly occurred at 125:14:21:18:802 G.m.t. when a speed change occurred. For this to occur, bits 6 (speed 4, 15 ips) and 7 (speed 1, 24 ips) of the command word from PF2 had to change from 1,1 to 0,0. The next event occurred at 125:15:21:25:802 G.m.t. when the mode changed from RCDA to stop. For this to happen, bits 1, 2 and 3 had to change from 1,0,0 to 1,1,1 on the command word from PF2. At 125:15:21:35:802 G.m.t., several events were initiated: 1) Between 125:15:21:35:802 and 125:15:21:36:802 G.m.t., a mode change from stop to record parallel (RCDP). For this to occur, bits 1, 2 and 3 of the command word from PF2 had to change from 1,1,1 to 1,0,1. 2) During the same 1 second period, the track selection transitioned from track 2 to track 1. For this to occur, bits 13, 14, 15, and 16 of the command word from PF2 had to change from 0,1,0,0 to 1,0,0,0. Also during the 1 second period, a speed change occurred from speed 1 (24 ips) to speed 4 (15 ips). For this to occur, bits 6 and 7 had to change from 0,0 to 1,1. No indication of motion was present at this time, and the duration of this record parallel mode was 2 seconds. The next event occurred at 125:15:21:37:802 G.m.t. when a transition from RCDP to RCDA occurred. For this to occur, bits 1, 2, and 3 of the command word had to change from 1,0,1 to 1,0,0. At the same instant bits 6 and 7 of the command word had to change from 1,1 to 0,0 to initiate the change in speed from 15 ips to 24 ips. The OPS-2 recorder continued in the RCDA mode on track 1 at 24 ips until commanded by uplink to standby. All other items on PF2 (antennas, payload bay doors and other OPS-2 recorder actions) all behaved nominally and no electrical power anomalies were observed. The suspect hardware from the payload MDM interface was removed from OV-103 on June 6, 1991 and shipped to the vendor (Honeywell, Phoenix, AZ) for testing. The vendor could not repeat the anomaly. As the precautionary measure, the hybrid components in the interface cards that feed directly into the interface will be replaced. The components replaced will include 4 parts on the DOL card (IOM 10) that sends commands to the OPS recorder and one part on the IOM select hybrid will be replaced on the analog-to-digital connector module. The four components being replaced on the IOM 10 include the bus receiver hybrid, the bus driver 3 hybrid, the DO5 control hybrid, and the bus control 2 hybrid. The box will then be re-ATP'ed (Acceptance Test Procedure), sent to the Shuttle Avionics Integration Laboratory (SAIL) for 500 hours of run time which is the normal procedure if the problem cannot be identified. No generic issues have been identified with these hybrids. There are seven types of MDM's (19 total) determined by card configuration on each Orbiter. Those containing older 5000 series boxes could still contain hybrids with the same lot and date code; it is less likely that these are installed in the 600 series boxes. Currently OV-102 has three-5000 series boxes installed, OV-103 has four, and OV-104 has six. The vendor will do part level testing and analysis on the removed hybrid components. The results will be discussed at an Engineering Status Review to be scheduled by Rockwell Reliability within approximately 60 days. CONCLUSION: The most probable cause of the anomaly is MDM PF2 hybrid component failures. CORRECTIVE_ACTION: Removed and replaced MDM PF2 on June 6, 1991. MDM PF2 was sent to the vendor on June 6, 1991 for testing of suspect component parts. EFFECTS_ON_SUBSEQUENT_MISSIONS: None; no generic issues have been identified for these hybrids.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:34	Problem	**FIAR**	**IFA** STS-39-V-05	INST
INCO-01	**GMT:** 118:12:08		**SPR** 39RF05	**UA**	**Manager:**
			IPR	**PR** INS-3-13-0514	
					Engineer:

Title: Modular Auxiliary Data System Frequency Division Multiplexer 2 Multiplexers 1 and 2 Built in Test Equipment Failures. (ORB)

Summary: DISCUSSION: Modular Auxiliary Data System (MADS) Frequency Division Multiplexer (FDM) 2 (ser. no. 16, part number MC409-0010-0003) multiplexers (MUX) 1 (MSID V78X9390E) and 2 (V78X9391E) built-in test equipment (BITE) indications annunciated, isolating a circuit failure to those areas when MADS was powered up at approximately 118:12:08 G.m.t. to capture orbital maneuvering subsystem (OMS) 2 burn data. The BITE's functioned as expected at 124:06:55 G.m.t.

An analysis of the postflight data dump showed that MUX 1 data was present and MUX 2 data was lost during OMS-2. Based on these data, regulator 2 of power supply 1 was the source of the problem since it supplies power to MUX 2 and the BITE status for MUX 1 and 2. FDM 2 has been removed and sent to the vendor for testing, tear-down and evaluation (TT&E) to determine which part failed and the reason. A review of the 13 previously reported failures of FDM ser. no. 16 showed no similar problems. This type of failure is acceptance-test-procedure (ATP) detectable at the supplier. A loss of data may occur if this type of problem develops on a channel during flight, but the problem is undetectable until the postflight data retrieval. Because MADS data are currently determined to be Criticality 3/3, this type of problem poses no impact to any mission on which the problem may occur. CONCLUSION: No impact to operations. Loss of Criticality 3/3 frequency modulated (FM) data. CORRECTIVE_ACTION: Remove and replace FDM 2. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 003:09:12	Problem	**FIAR**	**IFA** STS-39-V-06	C&T
INCO-06	**GMT:** 121:20:46		**SPR** 39RF06	**UA**	**Manager:**
			IPR 48V-0025	**PR**	
					Engineer:

Title: Rendezvous Radar Loss of Lock (ORB)

Summary: DISCUSSION: During the mission, the rendezvous radar lost lock with the Shuttle Pallet Satellite-II (SPAS-II) a number of times in all modes except manual (which was not used). No corresponding indications of radar system anomalies were noted. Postflight testing of the radar at KSC revealed no hardware problems. The

SPAS-II attitude data and Ku-Band radar data are being reviewed to determine whether the returned signal from the SPAS-II were responsible for the radar losing lock.

CONCLUSION: The cause of the anomaly is currently unknown. The most probable cause is a varying return signal due to SPAS-II attitude excursions or target characteristics during retrieval operations. Analysis of the SPAS-II attitude data and the Ku-Band radar data is continuing. CORRECTIVE_ACTION: None. EFFECTS_ON_SUBSEQUENT_MISSIONS: Specific requirements for the rendezvous radar are mission dependent. If radar were required to complete mission operations, a similar anomaly could impact mission success, although procedures exist for performing rendezvous and proximity operations without the radar. OV-103's radar will not be required for mission operations until after its Orbiter major downtime period (OMDP).

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 003:00:56	Problem	**FIAR** RCA-TV-G-0394	**IFA** STS-39-V-07	GFE
INCO-05	**GMT:** 121:12:30		**SPR**	**UA**	**Manager:**
			IPR	**PR** COM-3-13-0173(VSU); COM-3-13-0174(RSU)	**Engineer:**

Title: Closed Circuit Television System Telemetry Freeze and Video Loss (GFE)

Summary: DISCUSSION: During the STS-39 mission, three separate incidents occurred that indicated a problem with the Orbiter's closed circuit television (CCTV) system video switching unit (VSU). They are as follows:

1) The pan and tilt angles displayed on TV monitor (TVM) 1 were frozen and remained the same regardless of which camera input was selected. The crew was unable to reset the pan and tilt angles using the panel A7 reset switch. Also, the angles could not be reset with uplinked commands. When using TVM 2, all data on both monitors disappeared and the automatic light control (ALC) and GAMMA lists on panel A7 did not light for the video inputs selected for TVM 2. 2) The crew was unable to record Camera C video onto the onboard video tape recorder (VTR) 2. The camera C video input to the VTR comes from the VSU monitor 3B output, which is tapped off the downlink video output. The downlink video from camera C, however, was nominal. 3) On two separate occasions, the crew was unable to display video from the remote manipulator system (RMS) end effector (EE) camera. On the first occurrence, the EE video appeared on the monitor for a short time and then disappeared. The crew switched to the elbow camera, but no video was displayed from that camera either. After cycling power on the RMS cameras, video was displayed from both cameras. The video from the RMS cameras was then lost a second time. After this second occurrence, the video control unit (VCU) power was cycled and again video was recovered from both RMS cameras. CONCLUSION: During postflight troubleshooting: 1) Data could not be display on either TVM 1 or TVM 2. Consequently, the pan and tilt angle anomaly could not be verified. 2) Video could not be recorded from camera C. Apparently, the VSU was not switching the camera C video to the monitor 3B video output. 3) The problem with the RMS cameras could not be reproduced. These problems appear to be due to a malfunction in the VSU's data stripping/data decoding circuitry. CORRECTIVE_ACTION: The VCU, which consists of the remote control unit and the VSU, was removed and replaced, and the functioning of the new units

was verified. The failed VSU was sent to the vendor, and the failure analysis for this component is still in work.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 004:20:16	Problem	**FIAR**	**IFA** STS-39-V-08	ECLSS, EPD&C
EECOM-03	**GMT:** 123:07:50		**SPR** 39RF07	**UA**	**Manager:**
			IPR 48V-0011	**PR**	
					Engineer:

Title: Supply Water Dump Nozzle Temperature Drops (ORB)

Summary: DISCUSSION: At approximately 123:07:50 G.m.t., during supply water dump 5, the supply water dump nozzle temperature (V62T0439A) decreased approximately 35 ?F in approximately 2-1/2 minutes. The temperature then climbed back to its nominal value and the water dump was completed nominally. A similar occurrence was seen at approximately 125:02:00 G.m.t., during supply water dump 8. During the nozzle warmup for supply water dump 10, a similar, but smaller temperature drop was seen at approximately 125:19:57 G.m.t. Since water was not yet flowing during the dump 10 occurrence, icing was ruled out as a possible cause, and intermittent heater operation was suspected.

After the mission, the heater was run for 8 hours at KSC with no recurrence of the temperature-drop phenomenon. All accessible connectors in the supply water dump nozzle heater circuit were demated and inspected. Connector 40P311 (forward bulkhead, midbody side) had moisture in two spots, one of which was around pin 27 which carried the heater circuit. No other connector or wiring related anomalies were noted.   CONCLUSION: The temperature-drop phenomenon could not be reproduced and its cause is unexplained. The most probable cause of this anomaly is an intermittent circuit in the bulkhead feed-through connector (40P311). A possible problem exists with this bulkhead connector that is caused by the use of a silicon sealant internal to the connector that can prevent proper electrical continuity. CORRECTIVE_ACTION: The moisture in connector 40P311 was removed. One of the unused fuel cell and heater discrete measurements will be spliced into the supply water nozzle heater power circuit for STS-48. If the phenomenon recurs, this discrete measurement will verify whether the heater power circuit is interrupted. Replacement of the bulkhead connector is not possible for STS-48 because no spares are available.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None. If the phenomenon recurs, it appears to be transient and recoverable. Should the supply water nozzle heater completely fail, supply water can be managed through the flash evaporator or the waste water dump systems.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 005:14:05	Problem	**FIAR** BFCE-029-F007	**IFA** STS-39-V-09	GFE
CRSYS-01	**GMT:** 124:01:39		**SPR**	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Treadmill Exhibited Excessive Resistance. (GFE)

Summary: DISCUSSION: While using the treadmill on flight day 7, the Pilot reported an audible snap and the treadmill resistance increased to almost infinity. The treadmill was unusable for the remainder of the mission.

Postflight, the treadmill was dismantled to inspect the governor system mechanical operation. A spring, which is adjusted by the exerciser using an outside knob, controls the modulation of the governor and tread resistance of the treadmill during running. This spring is connected to the governor mechanism through a shaft that passes through two ball bearings. It was discovered during the inspection that the bearings had disintegrated and that the shaft and spring were both missing. The loss of the spring results in the governor going to the fully braked position. The spring was later found in the cockpit. The shaft is still missing. The other three flight treadmills were inspected and no problems were found. As a precaution, the bearings are being replaced. The cause of the bearing failure is under investigation; however, the most probable cause is that the lubricant dried on one of the bearings. The resulting heating action caused by the shaft rotating inside the frozen bearing could have destroyed the other bearing. CONCLUSION: The failure was caused by one or both of the treadmill governor system bearings freezing. Once a bearing had frozen, the shaft began to spin, resulting in the tension spring popping loose. This caused the governor to go to the full-brake position. The cause of the bearing failure is under investigation at this time. CORRECTIVE_ACTION: New bearings have been installed on the STS-40 and STS-43 treadmills. The manufacturer suggests replacing the bearings with a new type of bearing. These new bearings are expected to be delivered by August 1, 1991. EFFECTS_ON_SUBSEQUENT_MISSIONS: No effect is anticipated on future missions with the bearings replaced.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:14:05	Problem	**FIAR**	**IFA** STS-39-V-10	D&C
GNC-01	**GMT:** 125:01:39		**SPR** 39RF08	**UA**	**Manager:**
			IPR 48V-0007	**PR**	
					Engineer:

Title: Left Hand Body Flap AUTO/MAN Push-Button Indicator Contact 3 Hard to Make (ORB)

Summary: DISCUSSION: During the STS-39 mission flight control system (FCS) checkout, the Commander reported that contact 3 of the left-hand body flap (AUTO/MAN push-button indicator (PBI) would only "make" when the switch was very firmly depressed. Redundancy management allows switch function if only 2 of 3 contacts are made. The switch did subsequently make and no impact to flight occurred.

CONCLUSION: Postflight troubleshooting confirmed that contacts 9 and 11 of the switch did not engage without excessive pressure. CORRECTIVE_ACTION: The switch was removed and replaced, and is undergoing analysis at RI/Downey. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. The switch will function if 2 of the 3 contacts are made, and the Pilot and Commander switches are redundant.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-39-V-12	MECH, LDGR
None	**GMT:** Postlanding		**SPR** 39RF10	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Right Outboard Main Tire Excessive Wear. (ORB)

Summary: DISCUSSION: Right outboard tire shredded 3 of the 16 cord layers within the tire during landing.

During landing, the vehicle touched down on the right main gear and rolled for approximately 399 feet touching down the left main gear. The gear touched down on the crown of the runway and crossed the crown twice during the rollout phase. The vehicle touched down at approximately 210.4 knots ground speed at a main gear touchdown sink rate of approximately 2 ft/sec and an estimated vehicle landing weight of 210,811 lb. The winds were 12 knots gusting to 16 from 155 degrees true. Braking was initiated at 136.5 knots ground speed with brake energies on the right hand outboard wheels of approximately 36.98 million ft-lb and maximum brake pressure of approximately 1533 psig. The tires were removed and sent to the manufacturer for materials analysis/Shearography. A preliminary report from Michelin indicates not anomaly existed within the tire materials and structure. Simulations were performed at Ames Research Center (ARC) and Langley Research Center (LRC) to determine if the STS-39 tire wear was nominal for the actual parameters to which the tires were subjected. At ARC, a flight crewman performed the landing rollout as closely to the actual flight data as possible. The results of this test indicated 1 cord less tread wear than actually occurred. These test results were analyzed and it was determined that the actual and test differed in that the ARC model uses a mid-value wear equation rather than a worst case. The wear model can have a two cord scatter in its data. In addition, the ARC simulation was consistent in location of the tire wear with the location of the wear on the actual tire. The new LRC model indicates that up to 2 cords of additional tire wear can occur with 35 million ft-lb of braking energy on the KSC surface, with zero degree yaw, with 54,000 lb vertical load, and at 120+ knots. Currently, a six cord tire wear limit is defined, which is based on engineering judgment and Wright-Patterson AFB load tests. The community based on the six cord limit on not exceeding 4 cords wear before peak loads and allowing for 2 additional cords of wear for the remainder of rollout. Dynamometer testing has indicated 8 cords of wear is survivable at 245,000 lb vehicle weight using a 15 knot crosswind profile. Tire-wear models developed at LRC and used at ARC to determine crosswind effects show tire wear is influenced by both increasing crosswind and increasing vehicle weight. Placards have been established that provide a margin against increasing crosswind after committing to a KSC landing (90-minute forecast). For a vehicle weight of less than 205,000 lb, a crosswind can be no greater than 12 knots peak; and for vehicle weights greater than or equal to 205,000 lb, crosswinds can be no greater than 10 knots peak. CONCLUSION: STS-39 data show the sensitivity of tire wear as a result of vehicle drift and/or steering inputs on the KSC crowned runway due to crew and environmental dispersions during the landing/rollout phase. Tire wear was within the predicted model scatter based on events that occurred. CORRECTIVE_ACTION: Increase tire wear margins by implementing use of new Commercial Tread Rubber Tire developed by Michelin and utilize new braking tire wear math model developed by LRC. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 008:06:55	Problem	**FIAR**	**IFA** STS-39-V-13	C&T
INCO-07	**GMT:** 126:18:29		**SPR** 39RF11	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Loss of S-band Downlink and Uplink on Entry. (ORB)

Summary: DISCUSSION: During entry on STS-39, S-band two-way communications via the Tracking and Data Relay Satellite (TDRS) were lost for approximately 12 minutes. During this period, there was also a loss of real-time data. The data were recovered from the OPS recorders after landing. In addition, a number of forward-link dropouts occurred during landing.

Analysis of Orbiter data indicates that the forward- and return-link communications were lost at 126:18:29:20 G.m.t. when the antenna management software selected the lower right aft (LRA) antenna. At that time, the presence of a plasma sheath due to atmospheric heating was confirmed by typical radar altimeter readings of lock onto plasma at a distance of 3 to 7 feet. The radar altimeter lock began at 126:18:27:05 G.m.t. and continued until 126:18:41:07 G.m.t. Measurements by the White Sands Ground Terminal of received power at the TDRS showed an almost instantaneous decrease to the background noise level simultaneous with the loss of communications. The S-band power amplifier output-power measurement remained nominal throughout the loss of communications, although the reflected-power measurement indicated a small increase over the on-orbit values. These indications are consistent with entry blackout due to a plasma sheath that severely limits RF propagation. Since the plasma is formed at the underside of the fuselage, communications through the lower antennas are significantly limited by the plasma, while communications through the upper antennas are relatively unaffected. The LRA antenna remained selected until 126:18:40:56 G.m.t., at which time the upper right aft (URA) antenna was selected. During the entire period that the LRA antenna was selected, both the forward and return links were lost. Commands were transmitted to select the alternate power amplifier and transponder, but these commands were not received by the Orbiter. After the switch to the URA antenna, a good return link with downlink data was established, but the forward link was only received sporadically. This was due to the line-of-sight to TDRS being near the tail, which is a zone of lower antenna gain and typically poorer performance. At 126:18:43:30 G.m.t., a stored program command switched the S-band system to the Space Tracking Data Network (STDN) mode and selected Merritt Island Launch Area (MILA) as the active site. Good forward and return links were established immediately and maintained throughout the remainder of the descent phase. (The LRA antenna was used after MILA was acquired and operated nominally.) At 126:18:55:09 G.m.t., approximately 30 seconds prior to touchdown, the MILA 9-meter 1 antenna encountered the North-South keyhole and ceased tracking the Orbiter. A decrease in signal strength of approximately 25 to 30 dB occurred as the Orbiter flew out of the main beam and in and out of side lobes of the MILA antenna. This was coincident with a series of forward link data dropouts. After touchdown, the Orbiter antenna select was commanded to the URA antenna at 126:18:56:40 G.m.t. to avoid potential RF hazards to ground personnel. However, the selection of the aft beam in conjunction with the lack of MILA antenna pointing resulted in a low (-96 dBm) signal level. At 126:19:00:05 G.m.t., the forward beam was commanded and resulted in an 18 dB increase in signal strength at the Orbiter. Additional analyses to be performed include comparisons of the Orbiter antenna selections with those expected from the Best Estimate Trajectory data. During the entry phase, the antenna management software was executed by the BFS and the antenna switch was controlled by the PF2

MDM. CONCLUSION: The loss of communications during entry resulted from entry blackout. Entry blackout occurs whenever the lower antennas are selected while atmospheric heating is generating a plasma sheath that blocks RF propagation. Communications through the upper antennas are not affected. The conditions on STS-39 that contributed to the extended blackout with TDRS were a high orbit inclinaton, KSC landing, and extended roll-attitude duration required for cross range make-up. CORRECTIVE_ACTION: No hardware troubleshooting or changeout required. The performance of S-band antennas and transponder prior to and after the blackout was nominal. Predictions of blackout for nominal mission landing times can be made as part of mission planning. Short-term trajectory/attitude analysis would have to be performed in near real-time for early/late landings or alternate landing sites. Handover to East TDRS may be an option to avoid or minimize blackout for some KSC landings. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-39-V-14	D&C
None	**GMT:**		**SPR** 39RF13	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: The Right Rotational Hand Controller Positioning Mechanism Slipped. (ORB)

Summary: DISCUSSION: The Pilot reported that at approximately the time the spacecraft became aligned on final approach, the rotational hand controller (RHC) positioning mechanism allowed the assembly to rotate fully aft. The vehicle was under manual control at the time of the occurrence, but was being flown by the Commander. Postflight data analysis indicates momentary (one sample) commands of -6 degrees pitch and -1 degree roll were received from the pilot's RHC approximately 48 seconds prior to main gear contact. There was no apparent effect on vehicle control. The crew state that immediately following the occurrence, the tightening knob seemed difficult to move in either direction. Postflight, the securing knob was found to be in the fully extended (loosened) position and some initial resistance was noted when tightening it. An inspection of the positioning mechanism revealed that it was operating normally. Preflight procedures (reference OMI S0007V2) require that both forward RHC's be adjusted and the knobs be verified tight. KSC has confirmed that this sequence was verified.

CONCLUSION: The cause of this anomaly is unknown. The positioning mechanism was verified as operational, and existing preflight procedures are considered adequate to insure proper positioning and tightening. CORRECTIVE_ACTION: A crew procedures change request is being submitted to check the adjustment knobs for tightness prior to the deorbit phase of the mission. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.